Lecture 16 – 08/02/04

Administrivia: * Grades coming up

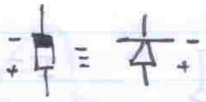
Last date for grade corrections (excluding final) is 08/11/04.

* Make up finals – email Bart before 08/06 w/ valid reason

Regular final: Thurs. 08/12/04 – 3-6 PM

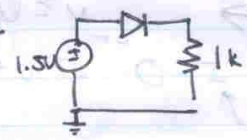
Pop Quiz

In lab: Using 1N 4148 Diode



Do not reverse bias a diode too much

Recall



KVL: $1.5 = v + v_R = v + IR$

$1.5 = v + 10^{-15}\left(e^{\frac{v_D}{V_{th}}} - 1\right)(1000)$

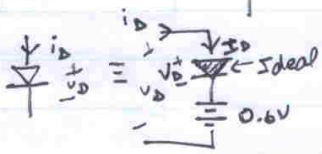
TI:99 → $\boxed{v = 0.712V}$

Note: $V_{th} \triangleq \frac{kT}{q}$ ← thermal voltage ≈ .026V @ room temp

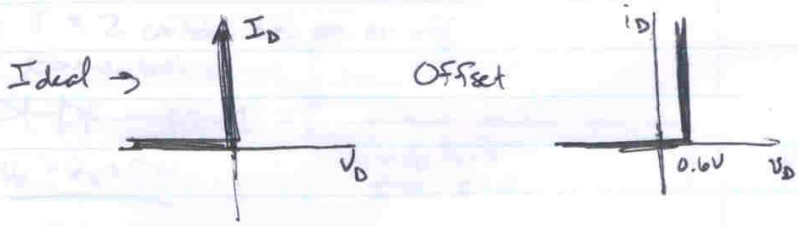
Now: Offset diode model

Recall: Ideal Diode

Offset Diode Model



$\boxed{\begin{aligned} i_D &= I_D \\ v_D &= V_D + 0.6 \end{aligned}}$



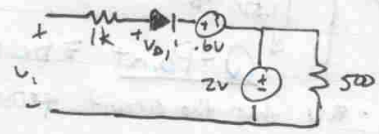
Ex. $v_D = 0.1$

$V_D = 0.1 - 0.6 = \cancel{-.04}\ -.5$

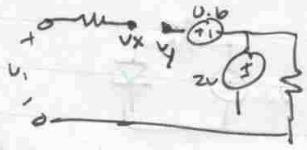
so ideal diode is off

Ex. 9.4

Using the offset diode model, determine v_1, for which diode first conducts in the circuit below



Start w/ diode off



$v_{D1} = v_x - v_y$, $v_{D1} = v_1 - 2.6$

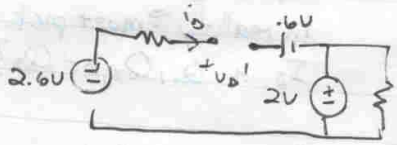
$v_D \leq 0$

$v_1 - 2.6 \leq 0$

$v_1 \leq 2.6V$, so $v_1 > 2.6V \Rightarrow$ Diode is

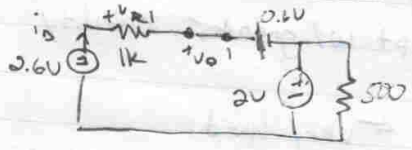
What if $v_1 = 2.6V$?

Diode can be either on or off



$i_D = 0$

$V_D = 0$



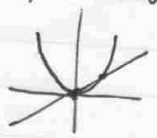
$V_D = 0$

$v_R = 0V \rightarrow i_D = 0$

Load-line method

↳ Graphical way to solve nonlinear circuits

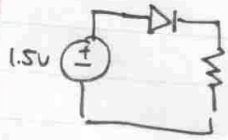
Ex. $y = x^2$ $y = x$ → where do they meet?



↳ Graph or set equal to each other

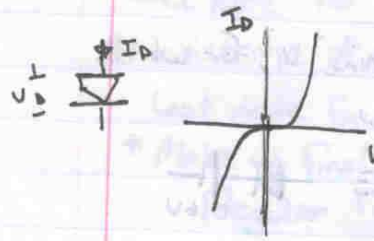
$x^2 = x \rightarrow x^2 - x = 0$

$x = 0, 1$



Graph

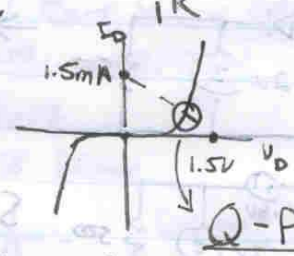
w/



KVL: $1.5 = v_R + v_D$

$1.5 = I_D(1k) + v_D$

$I_D = \frac{1.5 - v_D}{1k}$



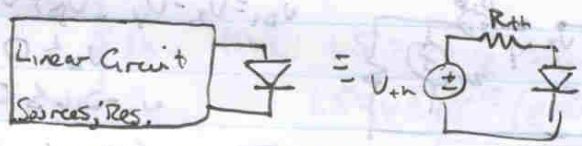
x-int: $v_D = 1.5V$

y-int: $I_D = 1.5mA$

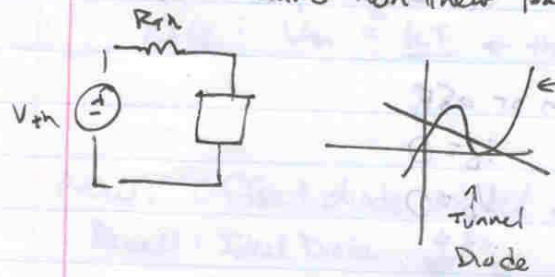
Q-Point ≡ DC Point

This gives us the i & v that the circuit operates at

Limitations



If contains non-linear parts, can't use load-line method



← 3 Operating Pts

In reality ⇒ must pick 1 pt.

Is it Q_1, Q_2, or Q_3?

Circuit will choose pt w/ greatest stability

← Very hard,

but we will approximate when we learn <u>small-signal analysis</u>.